Household Hazardous Waste in the Sanitary Landfill

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Household hazardous waste (HHW) disposal is a growing nationwide concern. HHW is perceived by some people to have a detrimental effect on the sanitary landfill environment and to require special collection programs to isolate it from the general waste stream.
This paper presents the results of a literature review, as well as ongoing research, to determine what volume of HHW might be reaching the sanitary landfill and their impacts. The exact impacts of these waste materials on the sanitary landfill are not known. However, data from solid waste research, codisposal research, and leachate and landfill gas characterizations are presented to help extrapolate --, hot those impacts might be. Finally, benefits deed from collection programs versus placina HHW sanitary landfills are discussed, versus issues such as costs, liability, health and safety, and other related issues.

Waste Characterizations

Of the early literature searched, one hazardous household product waste characterization was a study performed by the Los Angeles County Sanitation Districts on two landfills: Puente Hills and Mission Canyon- Out of the 185 tons of waste sorted at Puente Hills landfill, only 107 gallons of liquid HHW were detected. Household loads contained 0.0045% and mixed and commercial loads contained 0.28% of potentially unacceptable material.
Of 2,056 containers found at the Mission Canyon landfill that had contained materials that could be classified as hazardous, 1,889 were empty (92%). Detailed records on the containers (empty or with residue) were classified into six categories:

- 40% Household and cleaning products
- 30% Automotive products
- 16% Personal products
- 8% Paint and related products
- 3% Insecticides, pesticides, Herbicides
- 4% Other products considered hazardous

Containers with a residue were estimated for the percentage of material remaining. For example, in one truckload, 99 hazardous material containers were found. All of these were empty except five containers. One was a 2.35-oz bottle of butane fuel about 30% full. Four other bottles found to have 10% of their original contents included: a 5-oz bottle of shaving lotion, a 5-oz can of insect killer, a 17-oz (aerosol) can of disinfectant, and an aerosol enamel paint can. Of a total of 155 tons of waste sorted at the Mission Canyon landfill, 48.8 gallons of material were found that could be classified as hazardous. Overall. 0.13% of the total refuse mass could be classified as HHW.

The conclusions drawn from this study were that:

· quantities of potentially hazardous waste disposed of in municipal waste are extremely small.

· the vast majority of materials inspected and detected were common products which would only be considered hazardous if received in large bulk loads;

· the small -quantity of this type of material is effectively absorbed by the solid waste,

· consumers do not appreciable quantities of materials that could be considered hazardous.

A more recent waste characterization study was performed in King County, Wash., in which 33.7 tons of waste were examined. This waste total comprised residential, commercial, industrial, and self haul samples. Data presented in this paper showed that the residential type waste had a nonregulated hazardous waste component of 0.1% of the total municipal solid waste landfilled. This was based on estimated residuals from the waste and did not include the containers in which they were packaged. An EPA study by Fungaroli and Steiner reported compositions of the refuse they sorted from a 11 city, in southeast Pennsylvania to contain 0.8% paints and oils. This was the only potentially HHW they reported. This is somewhat in line with the Los Angeles study. Although the percentage is higher solely for paints and oils. it is not reported whether this was totally residential, commercial, or mixed. As in most studies of this type, it is probably a mixture of commercial and residential waste.

On a smaller scale, Kinman has hand-sorted 532 pounds of municipal refuse from low to medium income homes in the Cincinnati, Ohio, area specifically looking for HHW. Removing the residual hazardous household products from their containers and weighing those residuals yielded a total weight of 0.52 pounds of material. Although based on small sample size, this amounted to 0. 1% of the total refuse mass, which is very similar to the previous studies There were many other waste characterizations found in the literature review. Most of these were characterizations of solid municipal wastes from various solid waste/codisposal projects. A total of 40 waste characterizations representing areas of the southern, midwestern, western, and eastern United States and western Canada were found. Generally, the municipal wastes actually ,g to a sanitary landfill are classified into 11 categories.

Note that none of the general categories specifically includes HHW. A composite of these characterizations is given in Table I. From the 40 characterizations, the mean and ranges are reported for each waste category. The reported percentages are based on a combination of wet and dry weights of these wastes. Note in Table I that the greatest average percentage of municipal solid waste is paper, which can effectively absorb small quantities of HHW. As seen in this table, this would generally be the case for any landfill because of the large quantity of paper waste characterized in a landfill.

Proponents for preventing HHW from being disposed of in sanitary landfills base their waste characterization figures on collection days and consumption survey. Table II is a composite from waste collection programs reported around the United States indicating that fairly large quantities have been collected. However, what is typically found in the day-to-day garbage can inspection or an inspection of waste compactors is not these large volumes of HHW.

Consumers typically don't throw wastes of these types away in bulk. What is thrown away can be handled at the landfill if it is properly maintained and operated. Remember that these collection day figures are generally based on a one-day collection. It does not indicate the time period this waste was accumulated by the participant before the one-day collection program occurred. These collection day data do not contradict the relatively low figures found in the other waste characterizations.

TABLE 1
Mean and Ranges of Waste Categories Characterized in 40 Waste Characterization Studies Across the United States[37]

Category	mean. %	Range, %
Paper	46.7	36.5-54.7
Garden	9.5	0.4-25.0
Metals	8.5	4,0-14.7
Glass/ceramics	8.4	6.0-13.7
Food	7.8	0.9-18.2
Plastic, rubber, leather	5.3	2.0-9.0
Fines	4.2	3.0-6.1
Textiles	3.3	0.7-5.0
Wood	2.6	0.5-7.0
Rock, ash, dirt	2.5	0.5-10.0
Dirt	1.5	0.5-2.9

Landfill Leachate and Gas

Once waste characterizations have determined the amount of HHW entering the sanitary landfill, the true impacts should be determined by studying the effects of these wastes on the leachate and the gas from the landfill. Unfortunately, no studies have looked specifically at HHW impacts on sanitary landfill leachate and gas. However, the studies referenced below were performed with municipal refuse and codisposed refuse (municipal plus industrial sludges). Some of the industrial sludges would be similar to some HHWs, only in larger quantities. For example, some sludges used in these studies include solvent-based paint sludge, battery production waste, and chlorine production brine sludge.

The studies examined the leachate from the site; i.e., contaminated water produced as rain or other water infiltrates the refuse in a landfill site. The character of the leachate depends on the types of wastes received into the landfill, the material available for solution, cover material, the age of the landfill, biological activity, chemical activity, and the quantity of the infiltration water. Pohland and co-workers point out that the leachate quality and quantity are site-specific.

However different in quality and quantity, several research projects on solid municipal waste indicate that leachate toxicity decreased with time. In two projects"-" in which leachates have been monitored for up to 10 years, the leachate concentrations have peaked within the first year of leachate production (or after the landfill reached field capacity) and tapered off over the remainder of the studies.

Table III shows data for leachates in a young landfill (less than one year old), in a medium landfill (five years old) and in an older landfill (ten years old). The young and medium landfill data are taken from Cameron and Koch, whereas the 10 year sample is taken from Kinman et al. The pH of young landfills is generally more acidic, as seen in Table M. The other parameters listed tend to decrease with the age of the landfill, thus decreasing the toxicity of the leachate. This indicates that biological activity is taking place and that the wastes are being detoxified and treated within the lando. The leachate becomes less strong as time and nature do their job.

It was noted that Cameron and Koch also measured natural leachates directly from landfills and found them to be less toxic than the lysimeter "synthetic- leachates." Table IV shows the data for their measurements of the natural leachate. This shows that nature does do her job, reducing toxicity while degrading materials.

TABLE II

Examples of Household and Small Small Business Hazardous Waste Disposal Programs

Location	Waste Collected	No. of Participants
Anchorage, Alaska (I 982)	1,000 lbs + 35 barrels waste oil	48 households. 41 businesses
Palo Alto, Calif. (1983-1984)	Fall: 30 55-gal drums Spring: 55 55-gal drums	150 households
Redlands, Calif. (1984)	175 gal liquid 75 lbs solid	30 households
Sacramento, Calif. (1982, 1984)	1982: 54 drums, 2,400 lbs oil or recycling 1984: 165 drums	1982: 250 households 1984: 900 households
San Diego, Calif. (1984)	13,626 lbs in 5,057 containers	202 pickups, 88 people went to collection site
Woodland, Calif. (1984-1985)	33 55-gal drums + 100 gal motor oil	106 households
Florida (1 984)	250 lbs	50 schools, 86 gov't agencies, 2,513 households, 277 businesses
Barristable, Mass. (1983)	8,000 gals in bulk + 144 gals of waste oil	500+ households
Lexington. Mass. (1982-1983)	86 55 gal drums	316 households
Seattle, Wash.	6 gals, 90 lbs pesticides, 3 qts solvents, 40 gals oil	65 households
Madison, Wis.	2,872 lbs	325 households
San Bernardino, Calif.	60 drums	?
Orange County, Calif.	270 drums	600
Midland, Mich.	3,000 lbs, mostly paint, 10% pesticides	89

Ann Arbor, Mich.	110 gals paint, 35 gals solvent, 3 drums toxic chemicals, 100 lbs lye	83
Lexington, Mass. (1982)	7 55-gal drums paint, 4 drums pesticides	93
Andover, Mass. (1983)	165 gals paint, 55 gals oil, 55 gals waste, poisonous liquid, 30 gals pesticides	43
Bedford, Mass.	7 55-gal drums paint, 10 drums pesticides, fertilizers, asbestos, misc.	67
Greater Fan River area, Mass. (6 towns) (1983)	3 55-gal drums paint, 1 drum flammable liquid, 1 drum pesticides, 1 drum acid	30
Braintree, Mass. (1983)	6 55-gal paint, 7 drums oil, 2 drums flammable liquid, 1 drum acid. 3 30-gal drums pesticides, 10 5-gals flammable solvents	65

TABLE III
Chemical Composition of Landfill Leachate with Time[10, 14]

Parameter[a]	1 year	5 years	10 years
pH	4.8-5.2	5.0-6.6	5.6-6.1
Chemical oxygen demand	19,700-45,300	137-34,900	293-10,600
Total organic carbon	7,300-16,350	83-9,150	108-3,080
Total solids	10,000-33,000	718-18,400	1,920-5,530
Total volatile solids	5,350-20,330	124-10,300	770-3,330
Alkalinity	4,100-7,700	184-7,600	1,240-2,900
Chloride	620-1,880	5.3-730	115-193
Cadmium	0.005-0.89	<0.001-0.162	<0.05-0.009
Chromium	0.09-16.8	0.003-0.410	<0.025
Copper	0.03-0.12	0.009-0.09	<0.025
Iron	308-1,136	195-1,820	98.7-855
Lead	0.077-3.15	0.003-0.082	<0.05-0.08
Nickel	0.15-0.79	<0.005-0.342	<0.040-0.127
Zinc	46-298	0.18-75	<0.025-0.167

[a] All units are in milligrams per liter except pH.

Although leachate toxicity is reduced with time for some parameters, it may still be considered toxic. For example, another study compared the chemical characteristics of leachate from an operating section and from a 20-year-old abandoned section of a landfill in southeastern Pennsylvania. The authors noted (Table V) significant reductions in biochemical oxygen demand and chemical oxygen demand, whereas other parameters were reduced but less significantly. They concluded that the abandoned section, although less toxic, was still considered a source of contamination.

Small quantities of HHW in sanitary landfills do not keep the microorganisms from doing their job of biodegradation. HHW have little effect on leachate or gas quality.

Although leachate is toxic, it is not toxic because of HHW alone. All residential wastes have the "ingredients" to cause leachate toxicity, primarily from the breakdown of organic wastes placed in the sanitary landfill, including the "nonhazardous" materials such as paper, food, fecal matter, leaves, leather, metal, etc. Therefore, the threat would exist even if the "hazardous" household wastes were eliminated from the refuse.

In the case where it may still be a potential threat to water supplies, the leachate must be collected and treated. Several reports indicate that leachate can be treated effectively through recycling, physical treatment, combined physical/chemical treatment, conventional activated sludge plants, separate anaerobic and aerobic biological processes, public-owned treatment works (POTWS) or combinations of these.

TABLE IV
Natural Leachate Analysis[b]

Parameter	Natural leachate
pH	6.3-7.8
Chemical oxygen demand	720-4,720
Total organic carbon	810-1,600
Total solids	3,190-6,490
Total volatile solids	1,092-2,930
Alkalinity	1,350-3,510
Chloride	125-2,400
Cadmium	0.001-0.004
Chromium	0.025-0.085
Copper	0.01-0.05
Iron	1.6-30.3
Lead	0.023-0.065
Nickel	0.002-0.069
Zinc	0.43-1.32

[b] All units are in milligrams per liter except pH.

TABLE V
Leachate Comparison Between an Operating Section and a 20-year-old Abandoned of a Landfill in Pennsylvania[28]

Parameters[a]	Operating	Abandoned
Specific Conductance	3,000	2.500
Biochemical oxygen demand	1,800	15
Chemical oxygen demand	3,850	246
Ammonia-Nitrogen	160	100
Hardness	900	290
Iron (total)	40.4	2.2
Sulfates	225	100

[a] All units are milligrams per liter except specific conductance (microohms).

Certain studies have also examined substances that result from the decomposition of modern municipal refuse measured in landfill gas. Anaerobic conditions lead to the carbon containing compound conversion to methane (CH_4) and carbon dioxide (CO2), the two principal gases in landfill gas. In addition to these two major components. there are a large number of trace compounds in the gas.

One of the experimental goals is to be able to model the decomposition process in sanitary landfill. Table VI contains the trace volatiles in landfill gas. Several compounds were spiked into the experimental landfills so that spiked cells and unspiked cells could be compared. Note that all of the samples from the test cells contained the three compounds used in the spike: benzene, ethylbenzene, and toluene. Concentrations of benzene were about one-fourth of that in the spiked cell. Toluene concentrations exceeded one of the spiked cell concentrations in some of the samples. Ethylbenzene also exceeded the spike cell levels in some of the samples. This indicates that there are materials in the refuse that decompose to yield higher concentrations of the three compounds than when the refuse was specifically spiked to yield higher measureable concentrations of these compounds. Thus, they are there, even if one tries to eliminate them.

This is clear from Table VI, which has the compounds (benzene, toluene, and ethylbenzene) grouped according to relative concentrations found in landfill gas. All three compounds are very common solvents used in the manufacture of ingredients for some household products. Benzene is used for organic compound synthesis and, therefore, may be contained in some paints and inks. Ethylbenzene and toluene are used in paint manufacture and many coating materials. These compounds were found in all experimental landfill samples. Highest concentrations were in decreasing order: toluene, 128 mg/m^3; ethylbenzene, 105 mg/m^3-, and benzene, 12.2 mg/m^3. respectively.

In summary, leachate toxicity and gas production in a sanitary landfill. due specifically to HHW, are not found anywhere in the technical literature. However, based upon studies of codisposed municipal and industrial waste, it appears that landfill leachate and gas will have toxic components, regardless of whether the landfill contains HHW. Fortunately, in most cases, if a sanitary landfill is properly engineered, is on a suitable site, and is maintained and operated properly, leachate should not present a threat to groundwater or surface water supplies. The suggestion here is that the landfill acts biologically and chemically on the waste materials to make them less toxic. Nature, in time, will degrade the waste to a considerable extent. 'At the same time. the collection and treatment of the leachate is recommended to render a safe effluent.

TABLE VI
Trace Volatile Organic Compound Concentrations at 25°C

	Lysimeter (sample date)						
Compound.	21[b,c] (5/22/55)	21[c] (6/20/55)	22 (6/20/55)	22 (7/01/85)	23[b] (5/22/85)	33 (6/20/85)	35 (6/20/85)
Pentane	ND[d]	6.42	0.20	1.33	P[e]	ND	2.13
Tetrahydrofuran	ND	ND	0.406	ND	ND	0.653	0.408
Freon	ND	67.7	0.203	13.3	ND	1.08	ND
Benzene	12.2	12.1	1.02	1.05	0.40	1.30	0.821
Dichloromethane	0.05	27.7	0.71	54.1	0.017	2.71	0.321
Hexane	P	101.0	1.02	26.4	P	1.08	2.00
Toluene	11.2	128.0	20.3	21.1	3.62	33.5	48.0
1.1-Dichloroethylene	0.04	ND	ND	ND	0.032	ND	ND

1.2-Dichloroethylene	0.99	0.54	1.31	1.85	1.27	ND	0.651
1.1-Dichloroethylene	ND	ND	ND	ND	ND	ND	ND
o,m,p-Xylenes	13.3	175.0	112.0	118.0	12.2	249.0	120.0
Ethylbenzene	8.78	105.0	24.4	25.1	4.58	68.3	97.1
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND
Isooctane	ND	ND	ND	ND	ND	ND	ND
benzene	ND	ND	ND	ND	ND	ND	ND
Propylbenzene	p	33.7	8.11	11.8	ND	ND	3.00
Carbon disulfide	NO	67.7	0.965	128.0	0.018	8.02	1 0.8
Naphthalene	ND	ND	ND	ND	ND	ND	ND
Nonane	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	0.149	0.506	0.193	0.185	0.389	NO	0.13
1.1.2-Trichloroethylane	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	0.292	ND	ND	0.146	0.155	ND	ND

[a] All values are in milligrams per cubic meter.
[b] High sample volume, results tend to be low.
[c] Waste spiked with benzene, toluene, and ethylbenzene.
[d] ND, not detected: <5 mg in sample trap.
[e] P, identified, but not quantified.

Codisposal Projects

Further support for this position is found in additional studies of how some industrial wastes have behaved when codisposed with municipal solid wastes. Some of these industrial wastes studied have similarities to some of the HHW (for example, paint sludge). By comparing these, it may give the reader some idea of the capability of a landfill to accept and degrade these materials.

One study performed by Kinman et al found few significant differences between leachate parameters in landfill lysimeters with codisposed hazardous and nonhazardous industrial wastes and municipal waste and lysimeters with municipal waste only. Table VII presents data at the closure of this landfill project (ten years). One cell contained electroplating waste (heavy metals) mixed with municipal refuse and the other cell contained petroleum waste mixed with municipal refuse. The parameters of these two hazardous waste cells are averaged for the codisposal column. The other column represents four control cells with municipal refuse only. These parameters are averaged and presented in the municipal refuse column. Note that in ten years the leachate parameters shown here are not significantly different.

TABLE VII
Comparison of 10-year old Leachae Samples From Codisposed Cells Versus Municipal Refuse Only Cells[14]

Parameters[a]	Municipal refuse only	Codisposed refuse
pH	5.93	6.50
Conductivity	2,305	2,160
Total solids	2,950	3,090

Total volatile solids	1,481	1,330
Total organic carbon	852	214
Chemical demand	2.903	602
Alkalinity	1.793	2.395
Total Kjeldahl nitrogen	135	79
Phosphate-phosphorus	5	2
Chloride	161	118
Chromium	0.025	0.029
Cadmium	0.006	0.009
Copper	0.025	0.025
Iron	306.4	299
Nickel	0.08	0.19
Lead	0.06	0.11
Zinc	0.08	0.17

[a] All units are in milligrams per liter except pH and conductivity.

Other studies have reported similar results Pohland and Gould reported on comparisons of codisposed wastes with municipal wastes with specific emphasis on the fate of heavy metals. Their data indicate significant attenuation and reduction in leachate heavy metal concentrations. They report that the waste was disposed of in a controlled manner and with the benefit of leachate containment, collection, and recycling. The key here is control, operation, and maintenance.

Three different studies on codisposal of various industrial sludges with municipal refuse have also shown that the two waste groups behaved similarly. The industrial waste sludges codisposed in these projects included oil reclaiming clay, petroleum refinery incinerator ash. paint manufacturing sludge, solvent refinery sludge, tannery waste, electroplating sludge, metal finishing sludge, automobile assembly plant sludges (paint and putty), chlorine production brine sludge, and calcium fluoride/sewage sludge.

The first study concluded that the concentrations of the metals found at significant levels in the industrial waste leachates tended to decrease over the sampling period. Another conclusion in the same port showed that the results of the limited organic analyses for toluene, xylene, and cresol in the municipal waste leachates and the industrial waste leachates indicated that the concentrations of the organics in the leachates collected before and after contact with the industrial wastes were very similar.

The second study concluded that, although elevated levels of a limited number of constituents which could be related to the presence of the treated wastes were detected in the first meter of soil under the sludge/soil interface, in no case were these levels higher than the typical range for these elements in eastern U.S. soils. Therefore, attenuation of pollutants from the leaching medium by the underlying solid does not seem to be a major factor in maintaining high quality groundwater under the studied sites.

The third study produced the following results: 1) no release of metal contaminants from the electroplating sludge; 2) stabilized chlorine production brine sludge reduces release of toxic metals and chlorides, whereas untreated chlorine production brine sludge released significant quantities of aluminum, cadmium, copper, chlorine, mercury, sodium, and other dissolved solids; 3) calcium fluoride/sewage sludge improved leachate quality.

What all three of these reports tell is that many of the industrial wastes experimented with in these codisposal projects behave similarly to landfills with municipal refuse only.

The State of Minnesota runs a codisposal program. Officials believe that some nonhazardous industrial wastes may be codisposed with the municipal refuse. They require specific screening procedures and tests to be performed before a waste can be accepted. Because the program is growing and has become so large, they are hoping to develop lists of industrial wastes that would be acceptable for codisposal. Some of the 102 waste types requested for codisposal have been grouped into 12 categories:

- paint
- agriculture
- organic resins
- sludge
- wood and papermill
- food
- foundry
- health care
- ash
- ink sludge
- petroleum spills
- other

Of the 102 requests, 53 were approved for codisposal. (They do not report specifically which wastes were accepted and how much).

Contrary to previous codisposal projects discussed, a codisposal study reported by Jones et al concluded that, in all cases, the codisposal of treated or untreated industrial wastes with municipal solid waste had significant effects on the character of the leachates produced. It must be noted that this lysimeter experiment was in the young to medium stage (four years) when these results were reported. As seen previously, in all lysimeter studies examined in this report. the early leachate parameters go to a peak concentration and then decrease through time of landfill operation. It is believed that with time similar results might be obtained.

In summarizing this section, most codisposal research work has demonstrated that codisposed refuse did not produce substantially different results compared with municipal waste disposed. The leachates were similar, gases produced were similar, and microorganisms were not significantly affected.

Collection Programs Versus Sanitary Landfill Disposal

Proponents for collection programs state that the advantages and goals of separating HHW from the general municipal refuse stream are: 1) it keeps hazardous materials which may cause groundwater problems out of the sanitary landfill; 2) it increases homeowners' awareness of HHW; 3) it educates homeowners about HHW; 4) it reduces exposure and injury to homeowners (health and safety); 5) it reduces dangers to sanitation workers; and 6) it provides for proper disposal.

Research indicates, as described earlier, that there are only small quantities of HHW, as compared with the total waste stream by weight. HHW has little effect on the quality of either the leachate or gas coming from sanitary landfills. Furthermore, the hazardous materials do receive some treatment in the sanitary landfill, whereas they receive little or no treatment in a secure chemical landfill. Although there is limited incineration capacity presently available, if these materials were incinerated, they would also receive treatment. Overall, this suggests that collection programs may not be necessary when .the materials are placed in a well-designed and well operated sanitary landfill.

In further response to the other collection program goals above, it may be said that the homeowner is more exposed to these products during use or when collecting, storing, handling, and transporting them to a collection center. If some chemicals were removed from the trash, this would reduce sanitation worker injury by 2-3%, according to available statistics from the National Institute for Occupational Safety and Health. More injuries occur from broken glass and other sharp objects in the refuse.

Costs of collection programs to date are extremely expensive. The costs average greater than $5,000 per ton of waste for various collection days presently held around the United States. Costs for disposal into a sanitary landfill are dramatically less ($5-17/ ton) with seemingly more benefit in treatment and less risk to the consumer.

Collection program costs to date have been subsidized by government on the local, state, and federal levels; by sponsoring chemical companies and hazardous waste firms; and by donations from a variety of organizations (private and public) in the form of money and/or services. Funding on a continuous basis is questionable at the very best.

Liability is another potential issue concerning collection programs. Technically, there is liability of collecting HHW and disposing of these materials in a Subtitle C Facility under Resource Conservation and Recovery Act laws. The issue to date has somehow circumvented RCRA law. Will it if collection programs continue? Who would be liable for these wastes if there is a problem at the secure chemical landfill in the future under the Comprehensive Environmental Response. Compensation, and Liability Act (Superfund)?

Conclusions

- HHW are present in extreme y low concentrations in municipal refuse. around 0.1% by weight.
- Small quantities of HHW in sanitary landfills do not keep the microorganisms from doing their job of biodegradation.
- HHW have little effect on leachate or gas quality.
- The sanitary landfill can absorb large quantities of hazardous materials with little change in either leachate or gas quality.
- Collection days for HHW may not be necessary when the refuse is disposed in properly designed and operated sanitary landfills.

References in Hard Copy Only.